Role Reversal: The Influence of Slot Machine Gambling on Subsequent Alcohol Consumption

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Compliance with Ethical Standards

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Conflict of Interest statement

LC is the Director of the Centre for Gambling Research at UBC, which is supported by the Province of British Columbia government and the British Columbia Lottery Corporation (BCLC). The BCLC is a Canadian Crown Corporation. The slot machines used in the present study were provided to the Centre by the BCLC. The Province of British Columbia government and BCLC had no further involvement in the research design, methodology, conduct, analysis or write-up of the study, and impose no constraints on publishing. LC has received a speaker honorarium from Svenska Spel (Sweden) and accepted travel/accommodation for speaking engagements from the National Center for Responsible Gaming (US) and National Association of Gambling Studies (Australia). He has not received any further direct or indirect payments from the gambling industry or groups substantially funded by gambling. He has received royalties from Cambridge Cognition Ltd. relating to the licensing of a neurocognitive test. The other authors declare no conflicts of interest.

Ethical approval

The study was approved by the University of British Columbia Behavioural Research Ethics Board (H14-02803). All procedures involving human participants were in

accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

Abstract

Experimental studies examining the relationship between alcohol use and gambling have focused predominantly on alcohol's influence on gambling behavior. There has been little consideration of the reverse pathway: whether gambling influences subsequent alcohol use. Two experiments examined whether gambling and gambling outcomes (i.e. profits during a gambling session) influenced subsequent alcohol consumption. Experiment 1 (n = 53) used an *ad libitum* consumption test, in which participants could request beverages during a 30 minute window. Experiment 2 (n = 29) used a beer taste test procedure, in which participants were asked to rate a series of beers. In both studies, male regular gamblers were assigned to watch a television show or play a modern slot machine for 30 minutes, before being provided with access to alcohol. On the *ad libitum* procedure, gambling significantly increased the number of alcoholic drinks ordered, the volume of alcohol consumed, the participants' speed of drinking, and their intention to drink alcohol. These effects were not corroborated using the taste test procedure. Across both studies, gambling outcomes were not associated with alcohol consumption. In conjunction with prior findings, the observation that gambling can promote alcohol consumption under certain conditions highlights a possible feedback loop whereby gambling and alcohol reinforce one another. However, the divergent results between the *ad libitum* and taste test experiments point to boundary conditions for the effect and raise methodological considerations for future work measuring alcohol consumption in gambling environments.

Keywords

Alcohol, gambling, slot machines, electronic gaming machines, ad libitum, taste test

Introduction

Gambling behavior and alcohol use are closely linked on multiple levels. As an excessive behavior, Gambling Disorder was re-classified alongside the substance use disorders in the DSM-5 (American Psychiatric Association 2013), and the clinical and neurobiological overlap is particularly strong between Gambling Disorder and the alcohol use disorders (Lister et al. 2015; Mann et al. 2017; Slutske et al. 2000). In the general population, individuals who drink alcohol are more likely to gamble and more likely to experience negative consequences from their gambling (Blankenship et al., 2007; French et al., 2008; Griffiths et al., 2010; Welte et al., 2001). Cross-sectional data do not by themselves elucidate the effects that either behaviour has on the other. Other survey research indicates that alcohol consumption *during* gambling sessions is common and can amplify negative consequences (Giacopassi et al. 1998; Welte et al. 2004). Experimental studies measuring effects of alcohol administration on laboratory gambling have found increases in risky and/or persistent gambling (e.g. Ellery and Stewart, 2014; Cronce and Corbin, 2010; Phillips and Ogeil, 2010; Ellery et al., 2005; Phillips and Ogeil, 2007), albeit with some exceptions (Breslin et al. 1999; Sagoe et al. 2017). There is some evidence that the effects of alcohol may be enhanced in people with gambling problems (Ellery et al. 2005; Ellery and Stewart 2014). These studies are consistent with neuropsychological theories for the disinhibitory and dysexecutive effects of alcohol (see Lyvers, 2000; Oscar-Berman and Marinkovi, 2007).

Only one experimental study has examined the reverse pathway, of how gambling influences alcohol consumption. Stewart and colleagues (2002) studied

recreational gamblers who were able to purchase beverages during a session of play on an electronic gaming machine (EGM) in a bar laboratory for 90 minutes. Compared to a control group who could purchase beverages while watching an action movie, the gambling group purchased more alcoholic beverages and fewer non-alcoholic beverages. This effect was observed even though the gambling group had more limited financial resources as their funds were split between purchasing drinks and gambling. In addition, the participants who consumed alcohol lost more money on the EGMs ($24 CAD) than participants who had not consumed alcohol, and losses were associated with greater negative affect. This study highlights a potential reciprocal relationship ('vicious cycle') between alcohol consumption and gambling behavior, with relevance for policy decisions regarding alcohol availability in gambling venues, as well as public awareness of the risks of combining alcohol with gambling in the home (for example, in online gambling).

The present study sought to update and extend the findings by Stewart et al. (2002) in a number of ways. First, in Stewart et al. (2002), drinking took place concurrently with gambling, so that the temporal dynamics of the effect remain ambiguous; do the effects of gambling continue when the player steps away from the machine itself? Second, slot machine design has advanced over the past decade (Schüll 2012), and we sought to corroborate the Stewart et al. (2002) findings using modern, fully electronic, multi-line slot machines. Third, in Stewart et al. (2002) alcohol appeared to enhance negative affect due to gambling losses, but there was no examination of gambling wins. Individuals often consume alcohol to regulate both positive and negative affective states (Cooper et al., 1995). In a Canadian survey, 20 - 30% of gamblers indicated they would spend money on alcohol if they won (Focal Research, 1998). Zack et al. (2005) described two subgroups of problem gamblers who

drank alcohol either in response to wins or to losing sessions; only the former group showed faster reaction times in processing alcohol-related stimuli. By using a shorter period of slot machine play (30 minutes), a proportion of our participants completed their session in profit, enabling a quasi-experimental comparison of alcohol consumption in 'winners' vs 'losers'.

Our participants were randomly assigned to the slot machine condition or to watch a television show, for the same length of time, in a different room that did not contain any gambling paraphernalia. Experiment 1 employed an *ad libitum* alcohol consumption procedure, based on Leeman et al. (2013), in which participants could order beverages from a research assistant. In two further differences from the previous study by Stewart et al. (2002), our participants were tested in groups of twos or threes (rather than individually) to account for social factors that typically moderate adult drinking behaviour (Corbin et al., 2008; Leeman et al., 2013), and we employed a wider range of alcohol consumption variables, including number of drinks ordered, a continuous measure of volume of alcohol consumed, drinking speed, and drinking intentions. We also measured the subjective response to alcohol using the Biphasic Alcohol Effects Scale (BAES; Martin et al., 1993). We hypothesized that slot machine gambling (compared to the control group) would potentiate alcohol consumption and drinking motivations. We further hypothesized that alcohol consumption would be influenced by gambling outcomes, with a tentative directional prediction that gambling net wins would increase alcohol consumption more than gambling net losses (Focal Research, 1998; Zack et al., 2005).

Experiment 1: *Ad libitum* alcohol consumption

Methods

Participants

Male student participants (n = 53, mean age: 22.9 years) were recruited via campus advertisements. Participants were required to be i) at least 19 years of age, the legal age for alcohol use and gambling in the jurisdiction, ii) social drinkers, defined by consuming at least one alcoholic beverage per week (mean units per week = 20.9, range = 4 - 41 units; for unit conversions, see Materials), and iii) recreational gamblers, defined as having gambled at least once per month in the previous three months, but not meeting criteria for problem gambling. Participants were excluded if they scored > 7 on the Problem Gambling Severity Index (PGSI; Ferris and Wynne, 2001) (indicative of probable problem gambling), if they reported previous or current neurological illnesses or head injuries, if they were taking medication that interacted with alcohol, or if they reported past history of alcohol misuse, gambling problems, or other mental health disorders. Females were excluded from the study given the risks of alcohol consumption in the case of undetected pregnancy.

The PGSI scores indicated that the sample comprised 10 (18.9%) non-problem gamblers (score = 0), 19 (35.8%) low-risk gamblers (score = 1 - 2), and 24 (45.3%) moderate-risk gamblers (score = 3 - 7). The most frequently endorsed gambling games of choice were poker and blackjack. Most participants (n = 48) were non-smokers. Participants received $20 (CAD) for their participation in the study, with an additional bonus of $0 to $12, calculated using a conversion chart from the credits remaining on the slot machine session (see below; mean bonus = $8.38). The study was approved by the University of British Columbia Behavioural Research Ethics Board (H14-02803). The data are available in the UBC Abacus Dataverse repository (hdl:11272/10624).

Procedure

Participants were randomly assigned to either play a slot machine (gambling condition; n = 28) or watch a television show (control condition; n = 25) for 30 minutes. Subsequently, both groups were able to consume alcoholic and/or non-alcoholic beverages at their leisure for 30 minutes. Test sessions took 2 hours and were all conducted in the afternoons (between 12pm and 5pm). Consistent with previous studies (Corbin et al. 2008; Leeman et al. 2013), participants were tested in groups of twos or threes, with each member of the group assigned to the same condition. Participants were booked into available test sessions individually so that they were generally not known to each other (in one pair, participants were classmates).

Prior to arrival, participants were telephone screened for eligibility. Participants were instructed i) not to consume any drugs for 48 hours or alcohol for 24 hours prior to testing, ii) to have a light meal 1-2 hours before arriving at the lab (see also Christiansen et al., 2013). To reduce demand characteristics, the information sheet portrayed the study as a test of how different social and environmental conditions influenced gambling and alcohol consumption as two instances of risk-taking.

Upon arrival, participants provided consent and proof of age. They were weighed to determine the maximum number of drinks they could consume (equal to an estimated blood alcohol concentration of 0.08%, the driving limit in Canada); the purpose of weighing was not revealed to the participant. Participants were breathalyzed to ensure sobriety (all participants registered zero), and then completed a number of questionnaire measures (see below, administered to ensure group comparability), and then entered either the ‘casino lab’ (gambling condition) or the movie room (control

condition). The casino lab contained four modern slot machines, a lounge area (consisting of three armchairs and a table), a bar fridge, and a bar that displayed bottles and cans of the available beverages.

In the gambling condition, participants were instructed to play the slot machine for 30 minutes. Previous studies in which participants chose how long to play laboratory EGMs for describe typical session lengths of approximately 30 minutes (Stewart et al., 2005; Barrett et al., 2015; Ellery and Stewart, 2014). Participants received instructions on how to play the slot machine, including the multi-line options, winning symbol combinations, and the bet requirements. The lab contained two identical 'Super Times Pay' S2000 Series machines (International Game Technology), which were three reel, 20 line games set at a 1 cent denomination and 90% return to player. For groups of two participants, both participants played at these machines (n = 26). For groups of three participants, the third participant (n = 2) played a 'DragonsFire' machine (WMS Gaming Inc), a five reel machine set at a 5 cent denomination, nine paylines, and a 92% return to player. Participants were given money to load into the machine ($40 = 4000 credits on Super Times Pay; $80 = 1600 credits on DragonsFire); these endowed amounts were selected in order to sustain participants for 30 minutes of play. To reduce volatility (and thus the chances of some participants exhausting their funds), participants were directed bet the minimum number of credits on the maximum number of paylines; this 'mini-max' strategy is the typical strategy among regular slot machine gamblers (see Harrigan et al., 2011). Bonus payments were based on the remaining number of credits such that participants finishing in profit received the maximum bonus of $12. For analysis of winning/losing, the remaining credits were coded as a continuous variable for correlational analysis.

Participants were able to speak to each other during play, but they were not permitted to change machines or order alcohol during play. On completion of the 30 minute session of play, the experimenter recorded the number of credits remaining on each machine, but did not provide any further verbal feedback to the participant, and the commensurate bonus was not disclosed until the end of the experiment. Participants were then moved to the lounge/bar area in the same room, with the slot machines still in view.

Participants were informed that the bar was open and they were able to consume beverages for 30 minutes. The bar offered four local beers (341 ml bottles; all 5% alcohol by volume) and four non-alcoholic beverages (330 ml cans). Beverages were ordered from a research assistant; at the start of the drinking period, participants were asked if they would like a drink and any subsequent orders were initiated by participants. The research assistant remained in the room but did not interact with the participants. The participants were able to engage in conversation with each other and there were magazines available to read. A maximum number of alcoholic beverages was calculated for each participant based on body weight; in practice, this was 3 - 5 bottles. The research assistant recorded the number and times of beverage requests, and measured any undrunk quantities on completion. Participants were debriefed about the study and remained in the laboratory until their BAC was below 0.08%.

In the control condition, participants were also tested in groups of twos or threes, in a lounge room containing a 72inch television, and a bar set up identical to the casino bar but without gambling paraphernalia. Participants watched the television comedy show ‘Modern Family’. Participants in the control condition threw a dice to determine their bonus payment ($0 – 12).

Materials

A number of questionnaires were administered to assess comparability of the two groups: 1) Alcohol Use Questionnaire (AUQ; Mehrabian and Russell, 1978) assessed regular alcohol use (past six months) using UK unit sizing from Nikolaou et al. (2013): one glass of wine: 1.5 units, one pint of beer: 2.4 units, one measure spirits: 1 unit, one bottle alcopops: 1.7 units; 2) Alcohol Expectancies Questionnaire (Fromme, Stroot, and Kaplan, 1993) examined positive and negative expectancies associated with alcohol; 3) Depression Anxiety Stress Scale-21 (Lovibond and Lovibond, 1995) measured subclinical levels of depression, anxiety, and stress over the previous week; 4) UPPS-P Impulsive Behavior Scale (Cyders and Smith 2008) measured facets of impulsivity.

Two further scales were used as state-related measures. The Biphasic Alcohol Effects Scale (BAES; Martin et al., 1993) measured the stimulant and sedative effects of alcohol using 14 adjective ratings (seven stimulant, e.g. 'elated', seven sedative, e.g. 'sluggish') typically associated with intoxication. Participants rated these feelings "at the present time" on a 10-point scale ranging from 0 ("Not at all") to 10 ("Extremely"). Stimulant and sedative items were summated to create two subscales. A single-item 'Intention to Drink' rating was taken: participants were asked to rate how many beers they intended to consume (0 to 5+). The BAES and Intention to Drink scales were administered at baseline and immediately following the gambling/television session. Intention to drink ratings were not available from five participants. An intention to drink change score was calculated by subtracting the time 2 rating from the baseline rating. The BAES was administered a third time at the end of the *ad libitum* period.

Statistical analysis

One participant exhausted their gambling funds in the 28th minute, but was retained for analysis. Only one participant requested any non-alcoholic beverages, and hence the analysis was restricted to alcohol consumption between groups. The gambling and control conditions were compared using independent-samples t tests thresholded at $p < .05$. The following dependent variables related to *ad libitum* alcohol consumption were assessed: i) number of alcoholic drinks ordered, ii) millilitres of alcohol consumed, iii) latency from receiving the first drink to requesting the second drink (i.e. speed of drinking), and iv) the intention to drink change score. BAES ratings were analysed using a 3 x 2 mixed-factorial ANOVA with Timepoint (repeated-measures: baseline, post-manipulation, post drinking) and Condition (gambling, control) as factors.

Results

There were no reliable differences between the gambling and control conditions in age, weight, PGSI gambling risk scores, intention to drink (baseline), alcohol expectancies, depression, anxiety and stress scores, or impulsivity (see Table 1). On the AUQ, there was a trend towards increased weekly alcohol use in the gambling condition ($t(51) = 1.90$, $p = .063$, $d_s = 0.53$). Across both conditions, weekly alcohol consumption (AUQ) predicted a greater number of alcoholic beverages ordered ($r(51) = .348$, $p = .011$) and larger volume of alcohol consumed ($r(51) = .330$, $p = .016$), but was not related to drinking speed ($r(48) = .-230$, $p = .108$) or the change in the intention to drink ($r(46) = .069$, $p = .640$).

[Insert Table 1 here]

Ad libitum alcohol consumption: Compared to the control condition, participants in the gambling condition ordered significantly more alcoholic beverages ($M = 2.79$, $SD =$

0.69; Control M = 2.36, SD = 0.57, $t(51) = 2.44$, $p = .018$, $d_s = 0.68$), consumed a greater volume of alcohol (M = 800ml, SD = 186; Control M = 658, SD = 176; $t(51) = 2.85$, $p = .006$, $d_s = 0.80$), had a faster speed of drinking (M = 9.52 minutes, SD = 3.90; Control M = 11.9, SD = 4.10; $t(48) = 2.14$, $p = .037$, $d_s = 0.59$), and showed a greater increase in their intention to drink (M = +0.13, SD = 0.34; Control M = -0.16, SD = 0.47, $t(46) = 2.42$, $p = .020$, $d_s = 0.71$) (see Figure 1a-d). Sensitivity analyses were run using ANCOVA with the AUQ weekly alcohol consumption variable included as a covariate; the effect of condition remained significant for volume of alcohol ($F(1,50) = 5.45$, $p = .024$) and intention to drink ($F(1,45) = 5.46$, $p = .024$) but not for beverages ordered ($F(1,50) = 3.57$, $p = .065$) or drinking speed ($F(1,47) = 3.13$, $p = .083$). PGSI scores were not related to alcohol consumption (all $p > .281$).

[Insert Figure 1 here]

To assess the impact of winning or losing in the gambling condition, the remaining credits on the slot machine (which was proportionate with their actual financial bonus) was correlated with the *ad libitum* variables. Eight participants finished the session in overall profit (i.e. with more credits than their initial endowment) and 20 participants finished in loss. There was no significant correlation between the number of credits remaining and alcohol consumption variables (all $p > .252$).

Subjective responses to gambling and alcohol: On the BAES stimulant subscale (see Table 2), there was a significant main effect of Timepoint ($F(2,100) = 11.4$, $p < .001$, $\eta_p^2 = .185$), driven by an increase in stimulant ratings after drinking (t_3) compared to baseline (t_1) and post-gambling (t_2) (both $p < .001$). There was no main effect of Condition ($F(1,50) = .029$, $p = .866$) or Timepoint x Condition interaction ($F(2,100) =$

1.90, $p = .155$). On the BAES sedative subscale, there was no significant main effect of Timepoint ($F(2,100) = 0.74$, $p = .479$), Condition ($F(1,50) = 0.01$, $p = .933$) or Timepoint x Condition interaction ($F(2,100) = 1.77$, $p = .176$).

[Insert Table 2 here]

Discussion

In student participants with some prior gambling experience, a 30 minute session of slot machine play increased subsequent alcohol consumption, drinking speed, and drinking intentions, compared with participants who watched a television show for an equivalent length of time. These results strengthen Stewart et al.'s (2002) earlier study of concurrent alcohol consumption during gambling, highlighting the potential reciprocal relationship between gambling and alcohol consumption. Alcohol consumption was not related to gambling profits or losses, although the continuous nature of the session outcomes and bonus payment may have obscured this effect. One concern in experiment 1 was that the *ad libitum* design could be susceptible to demand characteristics, whereby the participant might infer the study hypothesis (that slot machine gambling increases alcohol consumption) and then behave in line with their expectations. Experiment 2 sought to corroborate Experiment 1 using an alternative 'taste test' procedure, in which the participant is asked to rate different beers under the pretext of market research (see Christiansen et al. 2013; Jones et al. 2016; Marlatt et al. 1973). In this procedure, the tasting instruction obscures the true aim of measuring the volume of alcohol consumed, providing an unobtrusive measure. The taste test procedure has established construct validity and consumption is not shaped by participants' awareness that their consumption is being monitored (Jones et al. 2016). For this experiment, we

also enhanced the salience of winning and losing by binarizing the bonus payment based on overall profit or loss.

Experiment 2

Methods

Participants

We recruited 29 male past-year slot machine gamblers (age M = 24.5 years) via campus and community advertisements. No participants had participated in Experiment 1. In the only change to the eligibility criteria, we ensured that past-year gambling involvement included slot machines specifically. PGSI (Ferris and Wynne, 2001) scores indicated 8 (27.6%) non-problem gamblers, 14 (48.3%) low-risk gamblers, and 7 (24.1%) moderate-risk gamblers. Other inclusion criteria, procedures, and ethical approval was per Experiment 1, with the following changes. For the purposes of the taste test procedure, participants were tested individually (n = 23) or in pairs (n = 6) unknown to one another. In the gambling condition, two 1 cent multi-line slot machines were employed: 'DragonsFire' from Experiment 1 was reset to a 1 cent denomination and a 20 payline setting (92% return to player), and a second game Buffalo Spirit (WMS Gaming Inc) ran on identical settings. Participants were endowed $40 (4000 credits) to play and were instructed to play 20 lines at one credit per line (thus 20 cents per spin). For the outcome manipulation, participants were told if they had 4000 or more credits remaining at the end of the session, they would win a $10 cash bonus ('winners'), whereas if they had less than 4000 credits remaining, they would only receive $5 ('losers'). Feedback was given immediately after the gambling period. In the control condition, the $10 / $5 bonus was determined by a coin flip.

The taste test was conducted in a separate room from the casino lab and movie room, and thus no drinking cues were present during the gambling or control period. Participants (tested in pairs) completed the taste test in shielded booths to avoid social interaction and observation. For the taste test, participants were provided with five cups each containing 170 ml of local beers, each 5% alcohol by volume, labelled A-E on a serving tray. Participants were asked to taste and rate each beer, with an instruction that they could drink as much or as little of the beer as they wished in order to complete the ratings. The volume of beer was selected to ensure that all participants could consume the full quantity without exceeding the BAC threshold of 0.08%. Participants rated each cup for pleasant (unpleasant), flat (gassy), bitter (sweet), and tasteless (strong), and an overall liking rating, using 100 mm visual analogue scales (Jones et al., 2016). The Intention to Drink rating from Experiment 1 was replaced with two ratings, 'How thirsty are you right now?' and 'How strong is your desire to drink beer right now?'. At the end of the experiment, participants were asked to write down what they thought the purpose of the study was, to assess demand characteristics. Alcohol consumption from each cup was recorded after the participant was discharged from the lab.

Results

Participants were split into three conditions: the control condition (n = 8), gambling/win subgroup (n = 10), and gambling/loss subgroup (n = 11). The groups did not differ significantly in age, weight, PGSI gambling risk scores, or weekly alcohol consumption (see Table 3). The gambling/win group displayed higher scores on the AEQ sexuality subscale, and the two Urgency subscales on UPPS-P (see Table 3); note these differences would not survive correction for multiple comparisons (as the scales were

used to assess the comparability of the groups rather than as dependent variables, it is not clear that such correction is warranted).

[Insert Table 3 here]

On average, participants drank 54.5% (*SD* = 30.0) of the available beer. Self-reported weekly alcohol consumption (on the AUQ) positively predicted the volume consumed on the taste test, $r(27) = .507$, $p = .005$. For 21 participants for whom timing data was recorded on the taste test, the average time spent drinking was 7.59 minutes (*SD* = 3.54). Across conditions, 37.9% showed some awareness of the purpose of the study, although awareness was not associated with the volume consumed ($t(27) = 1.06$, $p = .299$).

Taste test consumption did not differ between the control (*M* = 466 ml, *SD* = 274), gambling/win (*M* = 421, *SD* = 250), and gambling/loss (*M* = 500, *SD* = 264) conditions ($F(2,26) = 0.24$, $p = .785$) (see Figure 2). There were no differences in the ratings of the beers (pleasantness: $F(2,24) = 1.23$, $p = .311$, $\eta_p^2 = .093$; liking: $F(2,26) = 0.01$, $p = .986$, $\eta_p^2 = .001$). The repeated-measures motivational ratings were analyzed based on the change score of timepoint 2 (post-manipulation) minus baseline, given that the short consumption period would limit effects at timepoint 3 (post- taste test). There was no reliable difference between groups on the Thirst ($F(2,26) = 0.35$, $p = .705$, $\eta_p^2 = .027$) or Desire for beer ($F(2,26) = 0.34$, $p = .717$, $\eta_p^2 = .025$) change scores (see Table 4 and Figure 2b). On the BAES, significant group differences were observed on both the Stimulant ($F(2,26) = 5.18$, $p = .013$, $\eta_p^2 = .285$) and Sedative ($F(2,26) = 8.66$, $p = .001$, $\eta_p^2 = .400$) subscales (see Table 4): the gambling/win condition was associated with higher BAES Stimulant change scores compared with the gambling/loss ($p = .005$) and control ($p = .025$) groups, with mirrored effects on the BAES Sedative scores ($p = .001$ and $p = .004$, respectively). Note that these effects preceded the taste test and thus

do not indicate a change in subjective response *to alcohol*. There were no associations between either the Stimulant ($r(27) = -0.21$, $p = .284$) or Sedative ($r(27) = 0.32$, $p = .088$) change scores and taste test consumption.

[Insert Figure 2 here]

[Insert Table 4 here]

General Discussion

In line with our predictions, Experiment 1 observed significant increases in *ad libitum* alcohol consumption following slot machine gambling compared to the control condition. This effect was not corroborated in Experiment 2 using an alcohol taste test procedure, although the sample size was smaller due to difficulties in recruitment of student participants specifically with past-year slot machine experience. Some effects in Experiment 2 were in the predicted direction, including the increase in the Desire to drink ratings in the two gambling groups, although effect sizes were small. By contrast, Experiment 1 detected moderate-to-large effect sizes for several measures of drinking behavior (volume consumed, speed of drinking, intentions to drink) between the two groups. How might these effects have been obscured by shifting to the taste test procedure in Experiment 2? The two procedures differ in some important ways that may affect their relative sensitivities. The *ad libitum* procedure allowed free choice of both alcoholic and/or non-alcoholic beverages in standard volumes (314 ml bottles) over a 30 minute period, whereas the taste test entailed rating five smaller (170 ml) cups of beer; while no time limit was imposed for the taste test, the beers were generally consumed in under 10 minutes. Hence, the *ad libitum* sessions were associated with greater consumption overall that may have enhanced the sensitivity of that procedure.

One specific concern with the *ad libitum* procedure is the possibility that demand characteristics could influence alcohol consumption. That is to say, participants may have inferred our hypothesis that gambling would increase alcohol consumption and behave accordingly. Against this interpretation, consumption levels in both experiments were predicted by self-reported alcohol use outside of the laboratory (see also Jones et al. 2016; Leeman et al. 2009, 2013). We assessed awareness of the study hypothesis directly in Experiment 2. Approximately one third of participants guessed the true aims of the study upon completion, although this awareness did not predict alcohol consumption levels or desire to drink beer (also seen in previous experiments, see Jones et al., 2016). Thus, there is no positive evidence to link the *ad libitum* results in Experiment 1 to demand characteristics, although we recommend that future studies using the *ad libitum* procedure employ measures of awareness to assess demand characteristics.

The shift from the *ad libitum* to the taste test procedure also altered some environmental factors that may influence drinking behavior. Experiment 1 tested participants in small groups, and during the drinking period they were encouraged to converse and socialize. Anecdotally, the research assistants noted a 'modelling' influence in the timing of when participants ordered their second beer (typically within one minute of each other, across the group). Previous studies substantiate these social influences; for example, drinkers consuming more alcohol in groups, and synchronisation in drinking behaviour (Larsen et al., 2009; Larsen et al., 2010; Quigley and Collins, 1999). Although these influences would be expected across both gambling and control conditions, they may nevertheless have acted to diminish individual differences within the gambling condition (e.g. winners vs losers). In Experiment 2, we sought to minimise these social influences by testing participants individually (or in

separate booths when testing pairs), although as alcohol use is often a social activity, this may have served to reduce overall consumption levels. The taste test also took place in a separate room without gambling paraphernalia, whereas our participants remained in the casino lab for the *ad libitum* alcohol session. Gamblers rapidly condition to cues associated with the gambling environment (i.e. lights, sounds, casino décor) that then become capable of eliciting behaviour and craving (e.g. Kushner et al. 2007; Sodano and Wulfert 2010). Considering the availability of alcohol in gambling establishments, and data indicating that many gamblers combine gambling with alcohol use (Giacopassi et al. 1998; Welte et al. 2004), it is plausible that gambling cues in Experiment 1 could have transferred to a motivational effect on drinking (see also (Wulfert et al. 2016; Zack et al. 2005). Subsequent studies may consider and formally test these 'cross-sensitization' effects. While we selected a control condition ('Modern Family') that was intended to be engaging but neutral, it may be fruitful to examine whether passive conditions with gambling associations, such as watching sports, could alter drinking behaviour.

The results of Experiment 1 corroborate the earlier finding by Stewart et al. (2002) that also relied upon the 'free choice' element of our *ad libitum* procedure. By using a shorter session of play than Stewart et al. (2002), our experiments contained a greater proportion of winners, although across both experiments, there was no evidence for a moderating effect of game outcome on alcohol consumption. Whereas Stewart et al. (2002) examined concurrent alcohol consumption during gambling, our study is novel in focusing on subsequent alcohol consumption; we consider both influences to be important for guiding policy, as the co-availability of gambling and alcoholic beverages varies across jurisdictions and game types. In Experiment 2, participants in the gambling/win condition displayed a "stimulant" effect (on the BAES) after the slot

machine session, indicating that our modifications to the bonus payment to enhance the salience of the gambling outcome seem to have been effective. The stimulant effect indicates that gambling wins increased arousal (see also Lole et al., 2012), albeit without influencing alcohol consumption. Conversely in Experiment 1, the BAES revealed a prototypical subjective response to alcohol (i.e. a short-term stimulant action at around 30 minutes, see Hendler et al., 2013) that did not differ between the gambling and control conditions. Both experiments thus point to the dissociation between alcohol consumption and subjective arousal.

In conjunction with numerous studies showing how alcohol intoxication increases risky and persistent gambling (e.g. Ellery and Stewart, 2014; Cronce and Corbin, 2010; Phillips and Ogeil, 2010; Ellery et al., 2005; Phillips and Ogeil, 2007), our *ad libitum* results (combined with those of Stewart et al. 2002) highlight a reciprocal feedback loop whereby gambling and alcohol consumption can reinforce one another. Such effects have relevance to public policy around the regulation of alcohol and gambling products in bars and casinos. The divergent findings between the *ad libitum* and taste test experiments also highlight some methodological factors that may guide future research in this area. As strengths, our experiments employed authentic, modern slot machines, and we recruited participants with experience of gambling and alcohol consumption. Groups were matched for relevant gambling, alcohol and personality measures, and both assays of alcohol consumption were correlated with real-world drinking behavior. As limitations, the shift from the *ad libitum* to taste test procedure created some further procedural differences, namely in social setting and the presence of gambling cues, such that we cannot conclusively isolate the alcohol test itself as the critical factor. In experiment 1, the gambling and control groups differed slightly in real-world alcohol consumption, although group differences in volume

consumed and intentions to drink survived controlling for AUQ scores. The samples in the two experiments also show some minor differences (e.g. PGSI and DASS-21 scores, compare Tables 1 and 3) that presumably reflect the tighter inclusion of slot machine gambling experience in experiment 2. The use of authentic slot machines also creates some challenges in operationalizing winning and losing outcomes in the laboratory; our win and loss conditions were quasi-experimental (i.e. we did not know which participants would win or lose), and participants gambled with endowed funds such that they did not lose their own funds, and wins were capped. Alcohol consumption may be influenced by specific events such as jackpot wins, bonus features, or winning streaks, which were not captured in our design. Although we took care to arrange all test sessions in the afternoon, consumption (and thus sensitivity) could have been increased with evening testing (e.g. Liang and Chikritzhs 2015). Finally, while we excluded participants with gambling or alcohol use problems for ethical reasons, the reciprocal links between gambling and alcohol use may be quantitatively or qualitatively stronger in such individuals.

References

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders (5th ed.)*. Washington, DC: American Psychiatric Association.

Barrett, S. P., Collins, P., & Stewart, S. H. (2015). The acute effects of tobacco smoking and alcohol consumption on video-lottery terminal gambling. *Pharmacology Biochemistry and Behavior*, *130*, 34–39. doi:10.1016/j.pbb.2014.12.015

Blankenship, J., Starling, R., Woodall, W. G., & May, P. A. (2007). Gambling and alcohol use: Trends in the state of New Mexico from 1996-1998. *Journal of Gambling Studies*, *23*, 157–174. doi:10.1007/s10899-006-9051-3

Breslin, F. C., Sobell, M. B., Cappell, H., Vakili, S., & Poulos, C. X. (1999). The effects of alcohol, gender and sensation-seeking on the gambling choices of social drinkers. *Psychology of Addictive Behaviors*, *13*, 243–252.

Christiansen, P., Rose, A. K., Cole, J. C., & Field, M. (2013). A comparison of the anticipated and pharmacological effects of alcohol on cognitive bias, executive function, craving and ad-lib drinking. *Journal of Psychopharmacology*, *27*(1), 84–92. doi:10.1177/0269881112450787

Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, *69*(5), 990–1005. doi:10.1037/0022-3514.69.5.990

Corbin, W. R., Gearhardt, A., & Fromme, K. (2008). Stimulant alcohol effects prime within session drinking behavior. *Psychopharmacology*, *197*(2), 327–37. doi:10.1007/s00213-007-1039-x

Cronce, J. M., & Corbin, W. R. (2010). Effects of alcohol and initial gambling outcomes on within-session gambling behavior. *Experimental and clinical psychopharmacology*, *18*(2), 145–57. doi:10.1037/a0019114

Cyders, M. A., & Smith, G. T. (2008). Emotion-based dispositions to rash action: positive and negative urgency. *Psychological Bulletin*, *134*(6), 807–828. doi:2008-14745-002 [pii]10.1037/a0013341

Ellery, M., & Stewart, S. H. (2014). Alcohol affects video lottery terminal (VLT) gambling behaviors and cognitions differently. *Psychology of Addictive Behaviors*, *28*, 206–16. doi:10.1037/a0035235

Ellery, M., Stewart, S. H., & Loba, P. (2005). Alcohol's effects on video lottery terminal (VLT) play among probable pathological and non-pathological gamblers. *Journal of Gambling Studies*, *21*(3), 299–324. doi:10.1007/s10899-005-3101-0

Ferris, J., & Wynne, H. (2001). The Canadian problem gambling index. *Ottawa, ON: Canadian Centre on Substance Abuse*.

Focal Research. (1998). *1997 / 98 Nova Scotia Video Lottery Players' Survey: Nova Scotia Department of Health Problem Gambling Services*. Halifax, NS.

French, M. T., Maclean, J. C., & Ettner, S. L. (2008). Drinkers and bettors: Investigating the complementarity of alcohol consumption and problem gambling. *Drug and Alcohol Dependence*, *96*(1), 155–164. doi:10.1016/j.drugalcdep.2008.02.011

Fromme, K., Stroot, E. a., & Kaplan, D. (1993). Comprehensive effects of alcohol: Development and psychometric assessment of a new expectancy questionnaire. *Psychological Assessment*, *5*(1), 19–26. doi:10.1037/1040-3590.5.1.19

Giacopassi, D., Stitt, B. G., & Vandiver, M. (1998). An Analysis of the Relationship of Alcohol to Casino Gambling Among College Students. *Journal of Gambling Studies*, *14*(2), 135–149. http://www.ncbi.nlm.nih.gov/pubmed/12766439

Griffiths, M., Wardle, H., Orford, J., Sproston, K., & Erens, B. (2010). Gambling, alcohol, consumption, cigarette smoking and health: Findings from the 2007 British Gambling Prevalence Survey. *Addiction Research and Theory*, *18*(2), 208–223. doi:10.3109/16066350902928569

Harrigan, K., Dixon, M., MacLaren, V., Collins, K., & Fugelsang, J. (2011). The maximum rewards at the minimum price: Reinforcement rates and payback

percentages in multi-line slot machines. *Journal of Gambling Issues*, (26), 11–29. doi:10.4309/jgi.2011.26.3

Hendler, R. A., Ramchandani, V. A., Gilman, J., & Hommer, D. W. (2013). Stimulant and sedative effects of alcohol. *Current Topics in Behavioural Neuroscience*, *13*, 489–509. doi:10.1007/7854

Jones, A., Button, E., Rose, A. K., Robinson, E., Christiansen, P., Di Lemma, L., & Field, M. (2016). The ad-libitum alcohol "taste test": Secondary analyses of potential confounds and construct validity. *Psychopharmacology*, *233*(5), 917–924. doi:10.1007/s00213-015-4171-z

Kushner, M. G., Abrams, K., Donahue, C., Thuras, P., Frost, R., & Kim, S. W. (2007). Urge to gamble in problem gamblers exposed to a casino environment. *Journal of Gambling Studies*, *23*(2), 121–132. doi:10.1007/s10899-006-9050-4

Larsen, H., Engels, R. C. M. E., Granic, I., & Overbeek, G. (2009). An experimental study on imitation of alcohol consumption in same-sex dyads. *Alcohol and Alcoholism*, *44*(3), 250–255. doi:10.1093/alcalc/agp002

Larsen, H., Engels, R. C. M. E., Souren, P. M., Granic, I., & Overbeek, G. (2010). Peer influence in a micro-perspective: Imitation of alcoholic and non-alcoholic beverages. *Addictive Behaviors*, *35*(1), 49–52. doi:10.1016/j.addbeh.2009.08.002

Leeman, R. F., Corbin, W. R., & Fromme, K. (2009). Craving predicts within session drinking behavior following placebo. *Personality and Individual Differences*, *46*(7), 693–698. doi:10.1016/j.paid.2009.01.024

Leeman, R. F., Corbin, W. R., Nogueira, C. B. ., Krishnan-Sarin, S., Potenza, M. N., & O'Malley, S. S. (2013). Individual differences in impaired control over alcohol

use. *Experimental and Clinical Psychopharmacology*, *21*(4), 303–314. doi:10.1037/a0033438.A

Liang, W., & Chikritzhs, T. (2015). Weekly and daily cycle of alcohol use among the U.S. general population. *Injury*, *46*(5), 898–901. doi:10.1016/j.injury.2015.01.029

Lister, J. J., Milosevic, A., & Ledgerwood, D. M. (2015). Personality traits of problem gamblers with and without alcohol dependence. *Addictive Behaviors*, *47*, 48–54. doi:10.1016/j.addbeh.2015.02.021

Lole, L., Gonsalvez, C. J., Blaszczynski, A., & Clarke, A. R. (2012). Electrodermal activity reliably captures physiological differences between wins and losses during gambling on electronic machines. *Psychophysiology*, *49*(2), 154–163. doi:10.1111/j.1469-8986.2011.01290.x

Lovibond, P. F., & Lovibond, S. H. (1995). *Manual for the Depression Anxiety Stress Scales (2nd ed.).* Sydney, N.S.W: Psychology Foundation of Australia.

Lyvers, M. (2000). "Loss of control" in alcoholism and drug addiction: A neuroscientific interpretation. *Experimental and Clinical Psychopharmacology*, *8*(2), 225–249. doi:10.1037/1064-1297.8.2.225

Mann, K., Lemenager, T., Zois, E., Hoffmann, S., Nakovics, H., Beutel, M., et al. (2017). Comorbidity, family history and personality traits in pathological gamblers compared with healthy controls. *European Psychiatry*, *42*, 120–128. doi:10.1016/j.eurpsy.2016.12.002

Marlatt, G. A., Demming, B., & Reid, J. B. (1973). Loss of control drinking in alcoholics: an experimental analogue. *Journal of Abnormal Psychology*, *81*(3), 233–241.

Martin, C. S., Earleywine, M., Musty, R. E., Perrine, M. W., & Swift, R. M. (1993). Development and validation of the Biphasic Alcohol Effects Scale. *Alcoholism: Clinical and Experimental Research*, *17*(1), 140–146. doi:10.1111/j.1530-0277.1993.tb00739.x

Mehrabian, A., & Russell, J. A. (1978). A questionnaire measure of habitual alcohol use. *Psychological Reports*, *43*, 803–806. doi:10.2466/pr0.1978.43.3.803

Nikolaou, K., Critchley, H., & Duka, T. (2013). Alcohol affects neuronal substrates of response inhibition but not of perceptual processing of stimuli signalling a stop response. *PLoS ONE*, *8*(9), 1–16. doi:10.1371/journal.pone.0076649

Oscar-Berman, M., & Marinkovi, K. (2007). Alcohol: Effects on neurobehavioral functions and the brain. *Neuropsychological Review*, *17*(3), 239–257. doi:10.1007/s11065-007-9038-6

Phillips, J. G., & Ogeil, R. P. (2007). Alcohol consumption and computer blackjack. *Journal of General Psychology*, *134*(3), 333–353. doi:10.3200/GENP.134.3.333-354

Phillips, J. G., & Ogeil, R. P. (2010). Alcohol influences the use of decisional support. *Psychopharmacology*, *208*(4), 603–611. doi:10.1007/s00213-009-1762-6

Quigley, B. M., & Collins, R. L. (1999). The modeling of alcohol consumption: A meta-analytic review. *Journal of Studies on Alcohol*, *60*(1), 90–98. doi:10.15288/jsa.1999.60.90

Sagoe, D., Mentzoni, R. A., Leino, T., Molde, H., Haga, S., Gjernes, M. F., et al. (2017). The effects of alcohol expectancy and intake on slot machine gambling behavior. *Journal of Behavioral Addictions*, *6*(2), 203–211.

doi:10.1556/2006.6.2017.031

Schüll, N. D. (2012). *Addiction by design: Machine gambling in Las Vegas*. Princeton University Press.

Slutske, W. S., Eisen, S., True, W. R., Lyons, M. J., Goldberg, J., & Tsuang, M. (2000). Common genetic vulnerability for pathological gambling and alcohol dependence in men. *Archives of General Psychiatry*, *57*, 666–673. doi:yoa9396 [pii]

Sodano, R., & Wulfert, E. (2010). Cue reactivity in active pathological, abstinent pathological, and regular gamblers. *Journal of Gambling Studies*, *26*, 53–65. doi:10.1007/s10899-009-9146-8

Stewart, S. H., Collins, P., Blackburn, J. R., Ellery, M., & Klein, R. M. (2005). Heart rate increase to alcohol administration and video lottery terminal (VLT) play among regular VLT players. *Psychology of Addictive Behaviors*, *19*(1), 94–98. doi:10.1037/0893-164X.19.1.94

Stewart, S. H., McWilliams, L. a, Blackburn, J. R., & Klein, R. M. (2002). A laboratory-based investigation of relations among video lottery terminal (VLT) play, negative mood, and alcohol consumption in regular VLT players. *Addictive Behaviors*, *27*(5), 819–835. doi:10.1016/S0306-4603(01)00213-1

Welte, J. W., Barnes, G. M., Wieczorek, W. F., & Tidwell, M.-C. (2004). Simultaneous drinking and gambling: A risk factor for pathological gambling. *Substance Use & Misuse*, *39*(9), 1405–1422. doi:10.1081/JA-120039397

Welte, J. W., Barnes, G., Wieczorek, W., Tidwell, M. C., & Parker, J. (2001). Alcohol and gambling pathology among U.S. adults: prevalence, demographic patterns and comorbidity. *Journal of Studies on Alcohol*, *62*(5), 706–712.

http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&dopt=Citation&list_uids=11702810

Wulfert, E., Harris, K., & Broussard, J. (2016). The role of cross-cue reactivity in coexisting smoking and gambling habits. *Journal of Gambling Issues*, (32), 28–43. doi:10.4309/jgi.2016.32.3

Zack, M., Stewart, S. H., Klein, R. M., Loba, P., & Fragopoulos, F. (2005). Contingent gambling-drinking patterns and problem drinking severity moderate implicit gambling-alcohol associations in problem gamblers. *Journal of Gambling Studies*, *21*(3), 325–354. doi:10.1007/s10899-005-3102-z

Table 1. Experiment 1: demographic and personality data for participants in the control and gambling conditions, mean (SD).

	Control	Gambling	t value (df 51)
Age	22.7 (3.25)	23.1 (3.03)	0.50
Weight (kg)	82.7 (10.1)	74.5 (10.3)	1.15
PGSI	2.32 (1.75)	2.54 (2.06)	0.41
AUQ (units/week)	18.3 (8.15)	23.2 (10.4)	1.90
Intention to Drink (baseline)	1.88 (1.01)	2.11 (0.96)	0.84
Alcohol Expectancies Questionnaire			
Social	27.3 (2.62)	26.5 (3.80)	0.90
Tension Reduction	7.96 (1.34)	7.75 (1.71)	0.49
Liquid Courage	14.2 (2.69)	13.8 (3.05)	0.64
Sexuality	9.96 (2.65)	9.39 (2.75)	0.76
Cog & Behav Impair	20.7 (4.61)	21.0 (4.68)	0.25
Risk & Aggression	13.4 (2.92)	12.5 (2.73)	1.26
Negative Self Percept	6.64 (1.96)	6.93 (2.18)	0.51
DASS-21			
Depression	4.64 (4.11)	7.14 (7.35)	1.50
Stress	10.3 (7.48)	12.6 (10.3)	0.93
Anxiety	4.80 (5.29)	7.79 (6.76)	1.78
Impulsivity			
Negative Urgency	27.4 (5.56)	26.2 (5.43)	0.79
Premeditation	19.4 (4.55)	20.8 (5.31)	1.02
Perseverance	18.1 (5.54)	19.8 (3.95)	1.33
Sensation Seeking	39.2 (5.02)	37.1 (6.73)	1.29
Positive Urgency	28.5 (7.68)	25.7 (8.02)	1.28

Note. PGSI = Problem Gambling Severity Index; AUQ = Alcohol Use Questionnaire; Cog & Behav Impair = Cognitive and Behavioral Impairment; DASS-21 = Depression, Anxiety and Stress Scale, 21-item version. There were no differences between groups, $p > .05$

Table 2. Experiment 1: Scores on the stimulant and sedative subscales of the Biphasic Alcohol Effects Scales, for the control and gambling conditions, mean (SD).

	Control	Gambling
Stimulant		
t_1	41.0 (8.75)	38.6 (10.5)
t_2	38.7 (9.51)	41.4 (10.8)
t_3	45.0 (9.12)	45.8 (9.39)
Sedative		
t_1	18.8 (10.2)	21.1 (12.0)
t_2	19.6 (11.7)	17.4 (10.4)
t_3	19.3 (10.9)	19.9 (10.6)

t_1 = baseline, t_2 = after slot machine gambling or TV control session, t_3 = after *ad libitum* session.

Table 3. Experiment 2, demographic and personality data for participants in the control, gambling/win and gambling/loss conditions, mean (SD).

	Control	Gambling/Win	Gambling/Loss
Age	23.4 (3.11)	25.9 (9.53)	24.0 (8.32)
Weight (kg)	72.7 (15.6)	79.4 (16.3)	87.9 (17.4)
PGSI	1.88 (1.55)	1.60 (1.84)	1.36 (1.63)
AUQ (units/week)	15.1 (5.80)	17.8 (6.84)	13.1 (7.16)
Alcohol Expectancies Questionnaire			
Social	24.1 (3.83)	25.7 (3.27)	25.3 (3.10)
Tension Reduction	7.25 (1.28)	7.90 (1.29)	7.09 (2.26)
Liquid Courage	11.9 (1.96)	14.7 (2.50)	12.6 (3.04)
Sexuality	8.50 (1.93)	11.1 (2.60)	8.45 (1.44)**
Cog & Behav Impair	17.6 (4.84)	20.8 (3.71)	19.1 (5.91)
Risk & Aggression	12.0 (2.20)	13.6 (3.06)	11.6 (3.11)
Negative Self Percept	6.38 (1.60)	7.30 (1.14)	5.82 (2.09)
DASS-21			
Depression	1.38 (1.41)	3.0 (4.0)	2.82 (2.96)
Stress	4.13 (3.27)	5.0 (4.81)	5.36 (5.37)
Anxiety	1.88 (1.55)	3.40 (2.55)	2.73 (2.37)
Impulsivity			
Negative Urgency	25.4 (4.37)	33.3 (6.13)	26.6 (7.50)*
Premeditation	22.1 (3.36)	24.3 (4.22)	22.6 (5.01)
Perseverance	21.1 (3.28)	22.8 (3.65)	20.9 (6.56)
Sensation Seeking	40.6 (6.41)	38.0 (4.35)	36.7 (7.09)
Positive Urgency	23.5 (6.93)	34.4 (11.0)	24.0 (7.44)*

Note. PGSI = Problem Gambling Severity Index; AUQ = Alcohol Use Questionnaire; Cog & Behav Impair = Cognitive and Behavioral Impairment; DASS-21 = Depression, Anxiety and Stress Scale, 21-item version. * = $p < .05$, ** = $p < .01$.

Table 4. The desire for beer, thirst and stimulant and sedative scores for the control, gambling/win and gambling/loss conditions in Experiment 2, mean (SD).

	Control	Gambling/Win	Gambling/Loss
Taste Test Ratings			
Pleasantness	35.4 (7.56)	38.5 (14.7)	43.3 (10.1)
Liking	45.8 (14.7)	45.1 (14.0)	44.5 (17.3)
Desire to drink			
t_1	47.6 (19.6)	47.7 (20.4)	32.9 (26.7)
t_2	57.3 (11.4)	64.8 (15.2)	50.8 (26.1)
t_3	48.3 (31.0)	44.2 (25.3)	28.9 (24.1)
Δ ($t_2 - t_1$)	9.63 (19.1)	17.1 (21.2)	17.9 (27.3)
Thirst			
t_1	60.1 (5.08)	54.5 (19.8)	43.9 (19.8)
t_2	64.3 (8.12)	53.8 (26.6)	52.2 (28.3)
t_3	28.6 (23.3)	28.2 (18.9)	33.9 (23.7)
Δ ($t_2 - t_1$)	4.13 (7.04)	-0.70 (35.1)	8.27 (20.1)
BAES Stimulant			
t_1	35.8 (14.6)	37.7 (11.9)	29.1 (9.75)
t_2	28.0 (12.4)	43.0 (11.8)	18.9 (9.65)
t_3	32.5 (14.1)	38.1 (13.4)	28.0 (8.91)
Δ ($t_2 - t_1$)	-7.75 (9.53)	5.3 (13.7)	-10.2 (10.9)
BAES Sedative			
t_1	16.0 (11.6)	25.1 (12.4)	16.3 (10.9)
t_2	20.5 (13.4)	12.9 (8.16)	23.3 (8.27)
t_3	19.4 (13.2)	17.3 (12.3)	17.5 (11.5)
Δ ($t_2 - t_1$)	4.50 (11.3)	-12.2 (9.76)	7.0 (12.3)

t_1 = baseline, t_2 = after slot machine gambling or TV control session, t3 = after taste test. Given short duration of taste tests, the change scores are calculated from t2 – t1.

Figure Legends

Figure 1. Experiment 1, a) number of alcoholic drinks ordered, b) volume of alcohol consumed, c) latency to order second drink, and d) intention to drink alcohol change scores (positive change score = greater score after the gambling/control manipulation), for participants in the control (dark grey) and gambling (white) conditions. All graphs display significant differences ($p < .05$). Error bars represent the standard error of the mean (SEM).

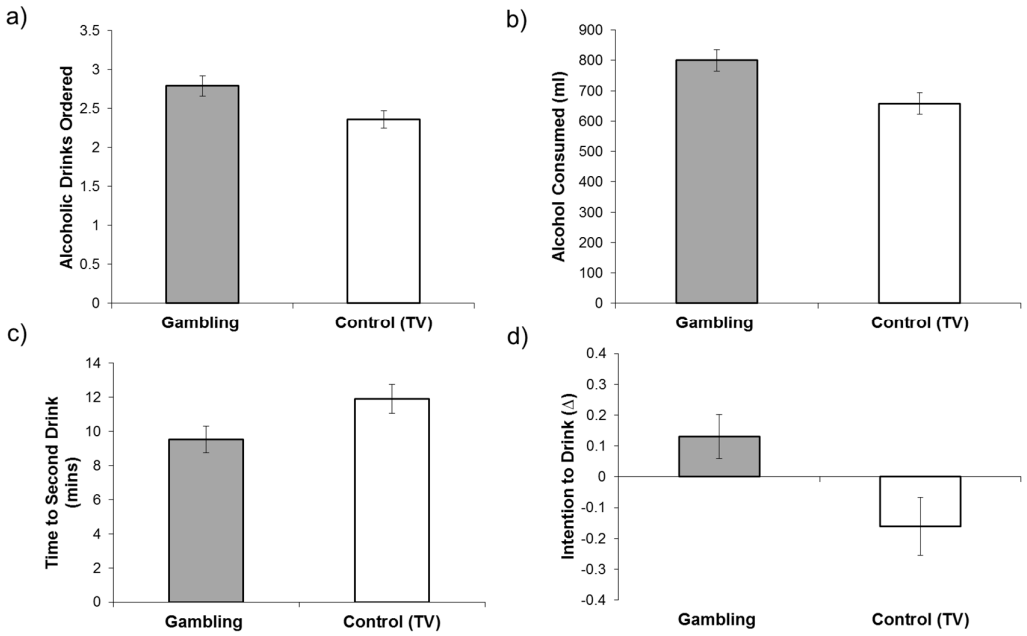

Figure 2. Experiment 2, a) volume of alcohol consumed, b) desire to drink beer change scores for participants in the control (white), gambling/loss (grey) and gambling/win (dark grey) conditions. Both graphs display non-significant differences. Error bars = SEM.